G-ESTIMATION USING A TRICHOTOMOUS EXPOSURE MEASURE

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Background and aims: The healthy worker survivor effect is a ubiquitous source of bias in occupational studies. Correcting for it requires causal methods, of which g-estimation is the best choice if follow-up is long and continues past the end of employment, when exposure can no longer occur. Previous applications of g-estimation have used a binary measure of exposure. Our ultimate aim is to apply g-estimation to a quantitative exposure measure; we begin by considering three categories instead of two.
Methods: We generalize a structural accelerated failure time model suitable for harmful exposures in order to examine the effect of exposure to oil-based metalworking fluids on survival time to heart disease death in a cohort of autoworkers. Confounding and censoring adjustments consider age, race, sex, plant, prior exposures to oil-based and other metalworking fluids, and temporary time off work. This last variable acts as a proxy for health status in order to prevent healthy worker survivor bias. G-estimation requires an exposure model; here we use linear regression. The observed distribution of annual exposure in this cohort is skewed: exposure is 0 for most of the observations, but some annual exposures exceed 9mg/m3. We define annual exposure in 3 categories (0, low, and high), with 0.1mg/m3 as the cutoff between low and high exposure, and assign the median within each category as the exposure.
Results: G-estimation produces an effect estimate of 1.038, representing the ratio of median survival time if no one were ever exposed to that under the observed exposures. (The ratio exceeds 1 because survival time is longer if unexposed.) This corresponds to a hazard ratio of 1.029 per mg/m3-year of exposure.
Conclusions: Methods that correct for the healthy worker survivor effect are more difficult to implement with a multi-level exposure measure, but success is critical for occupational epidemiology.